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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/828,592	04/21/2004	Betty Shu Mercer	TI 36275	5550

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EXAMINER	
FULK, STEVEN J	

ART UNIT	PAPER NUMBER
2891	

NOTIFICATION DATE	DELIVERY MODE
12/05/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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TH

Office Action Summary	Application No.	Applicant(s)	
	10/828,592	MERCER ET AL.	
	Examiner	Art Unit	
	Steven J. Fulk	2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 October 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) *11-15* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10 and 16-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *21 April 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Appeal Brief

1. In view of the Appeal Brief filed on October 12, 2007, PROSECUTION IS HEREBY REOPENED. New grounds of rejection are set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1, 2, 4-6, 9, 10, 16, 19 and 20 are rejected under 35 U.S.C. 102(b) as being anticipated by Kondo et al. '858.

Regarding claims 1 and 16, Kondo discloses a method for manufacturing an integrated circuit (figs. 7A-7E), comprising: forming transistor devices over a semiconductor substrate (101; col. 3, lines 40-41, substrate contains transistor devices); forming one or more metallization layers over the transistor devices, the one or more metallization layers interconnecting one or more of the transistor devices (transistors in substrate would inherently be wired to bond pad 103 through metallization layers); forming a protective overcoat (104) over the one or more metallization layers, wherein the protective overcoat has an opening located therein; forming a surface conductive lead (fig. 7D, 108) in the opening formed within the protective overcoat and over a barrier layer (105), a portion of the barrier layer extending beyond the surface conductive lead (fig. 7D); and subjecting the portion of the barrier layer to a dry etch to remove the portion and form a skirt (fig. 7E; col. 10, lines 33-39; col. 7, lines 65-67, diameter of barrier layer is larger than surface lead), the dry etch selective to the barrier layer (layer 105 is etched while underlying layers 104, 101, etc are not).

Regarding claims 2 and 4, the reference discloses the dry etch to include carbon tetrafluoride and chlorine.

Regarding claim 5, the reference discloses the barrier layer to be a tungsten-titanium barrier layer (col. 7, lines 11-12).

Regarding claim 6, the reference discloses the barrier layer to have a thickness ranging from 200 to 300 nm (col. 8, lines 62-65).

Regarding claims 9 and 19, the reference discloses the surface conductive lead to have a width ranging from 3 to 200 μm (col. 4, lines 20-21).

Regarding claims 10 and 20, the reference discloses the protective overcoat to comprise one or more layers selected from the group consisting of silicon oxide layers, and silicon nitride layers and phospho-silicate glass layers (col. 3, lines 56-62; col. 7, lines 36-49).

Claim Rejections - 35 USC § 102/35 USC § 103

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 7, 16 and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Lee et al. '692 or, in the alternative, rejected under 35 U.S.C. 103(a) as being unpatentable over by Lee et al. '692 in view of Bojkov et al. '048.

Regarding claims 1 and 16, Kondo discloses a method for manufacturing an integrated circuit (figs. 7-14), comprising: forming transistor devices over a

semiconductor substrate (fig. 7, substrate 10; ¶10, integrated circuits in substrate); forming one or more metallization layers over the transistor devices, the one or more metallization layers interconnecting one or more of the transistor devices (¶12, integrated circuits connected to bond pad 32 though metal layers); forming a protective overcoat (34) over the one or more metallization layers, wherein the protective overcoat has an opening located therein; forming a surface conductive lead (fig. 9, 38) in the opening formed within the protective overcoat and over a barrier layer (36), a portion of the barrier layer extending beyond the surface conductive lead (fig. 9); and subjecting the portion of the barrier layer to a dry etch to remove the portion and form a skirt (fig. 14; anisotropic dry etch results in skirt extension of barrier layer past surface conductive lead), the dry etch selective to the barrier layer (layer 36 is etched while underlying layers 34, 30, etc are not).

Regarding claims 7 and 17, the reference further discloses a seed layer (¶82) located between the barrier layer and the surface conductive lead and subjecting the seed layer to a wet etch (¶94; fig. 12, partial etching of copper surface conductive lead 38 by wet etch would inherently remove the copper seed layer to expose barrier layer for subsequent etching in fig. 14) prior to subjecting the portion of the barrier layer to the dry etch. See Erdos '071 for evidence that etching a surface lead and seed layer comprising the same material will result in removal of the seed layer and thinning of the surface conductive lead (Erdos, col. 4, lines 1-9), and the etch also exposes the barrier layer for subsequent etching.

Alternatively, assuming *arguendo* that it was not inherent to remove the seed layer when partially etching the surface conductive lead, it would nonetheless have been obvious to one of ordinary skill in the art to remove the seed layer by wet etch. Bojkov teaches a method of manufacturing an interconnect comprising forming a surface conductive lead (fig. 4, 301) in an opening formed within a protective overcoat (102); the lead formed over a barrier layer (fig. 1B, 105a) and a seed layer (105b), a portion of the barrier layer extending beyond the surface conductive lead; and subjecting the seed layer to a wet etch (¶34; Bojkov also teaches this etch will remove portions of the surface conductive lead 301, providing further evidence of the inherency argument above). Further evidence of obviousness of using a wet etch to remove the seed layer is provided by Applicant's Admitted Prior Art, stating that wet etching is a well known, effective method of removing the seed layer (Specification, page 2).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the seed layer by wet etch. One would have been motivated to do this because wet etching was a well know, conventional method of removing metal layers in semiconductor devices that provided the advantages of low cost and simple processing.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having

ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kondo et al. '858 in view of Ashby et al. '238.

Kondo teaches all of the elements of the claims as set forth in paragraph 3 above, but the reference does not explicitly teach the use of nitrous oxide in the dry etch chemistry. Ashby et al. teaches a method of etching tungsten titanium alloys (col. 4, lines 2-6) using a dry etch chemistry of carbon tetrafluoride and nitrous oxide, oxygen or chlorine (col. 4, lines 58-65; col. 6, lines 29-47) in the fabrication of integrated circuits (col. 4, lines 31-42).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the dry etch chemistry of Ashby et al. in the method for manufacturing an interconnect of Kondo. One would have been motivated to do this because Kondo taught that it was desirable to use a conventional dry etch that included Cl_2, BCl_3,CF_4, or the like (col. 10, lines 35-39), and Ashby et al. taught that a dry etch chemistry of carbon tetrafluoride and nitrous oxide, oxygen or chlorine was well known to be highly selective to the tungsten titanium alloy, thus removing the barrier layer without damaging the surrounding layers of the device (Ashby et al., col. 2, lines 40-52).

9. Claims 8 and 18 rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al. '692 in view of Bojkov et al. '048.

Lee or Lee in view of Bojkov teaches all of the elements of the claims as set forth in paragraph 6 above, but Lee does not explicitly disclose the wet etch

chemistry to include hydrogen peroxide and sulfuric acid. Bojkov teaches a method of etching the copper seed layer using a wet etch chemistry including hydrogen peroxide and sulfuric acid (¶34).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the wet etch chemistry of Bojkov in the method for manufacturing an interconnect as described by Lee or Lee in view of Bojkov. One would have been motivated to do this because Bojkov taught that a wet etch chemistry including hydrogen peroxide and sulfuric acid was a well known, convenient chemistry used to etch copper seed layers (¶34). Further evidence of obviousness of using a chemistry including hydrogen peroxide and sulfuric acid is provided by Backus '124, which taught that a wet etch chemistry including hydrogen peroxide and sulfuric acid (col. 2, lines 43-51) was a well known chemistry used to etch copper that also prevented cementation of copper onto other metal surfaces during etching (col. 1, lines 28-35), thus providing a clean surface conductive lead for subsequent wire-bonding and packaging steps.

Conclusion

10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Baek '067, Park '186, Datta et al. '611 and Agarwala '584 disclose a method of manufacturing an interconnect wherein a surface conductive lead is formed in an opening of a protective overcoat layer and over a barrier layer, wherein the barrier layer has a skirt extending past the surface conductive lead.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven J. Fulk whose telephone number is (571) 272-8323. The examiner can normally be reached on Monday through Friday, 9:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Baumeister can be reached on (571) 272-1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

12. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

SJF

B. WILLIAM BAUMEISTER
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

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Patent Examiner
Art Unit 2891

November 30, 2007